Overview of Broadcast Services Ground Station (BSGS) Specification
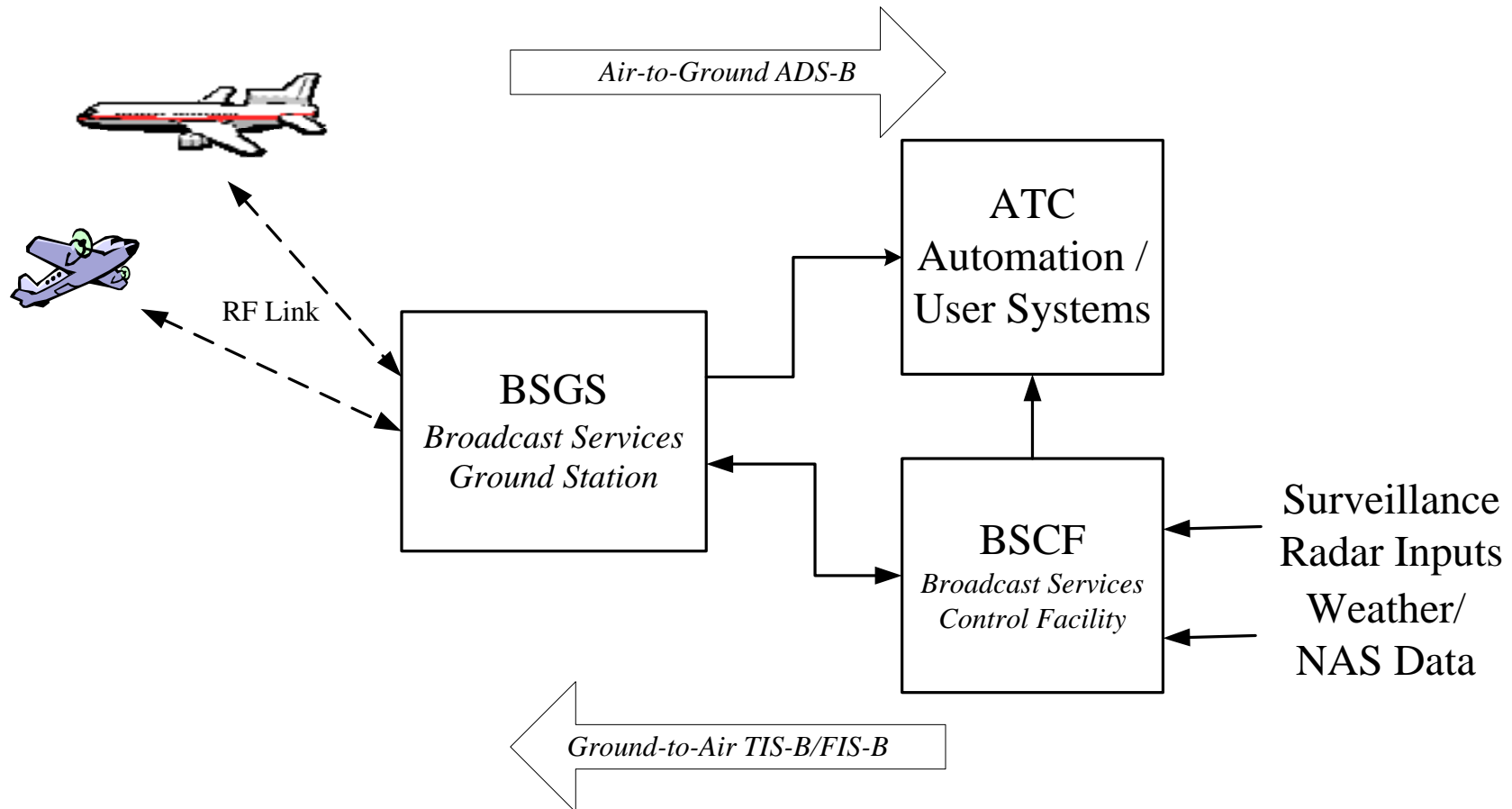
Federal Aviation Administration

Presented to: <RTCA SC-186 Working Group 3>

By: <Gary Furr>

Date: <December 7, 2005>

Overall Context Diagram

Air-to-Ground ADS-B

RF Link

BSGS
*Broadcast Services
Ground Station*

ATC
Automation /
User Systems

BSCF
*Broadcast Services
Control Facility*

Surveillance
Radar Inputs

Weather/
NAS Data

Ground-to-Air TIS-B/FIS-B

BSGS Major Functions

- ADS-B Message reception from equipped aircraft and ADS-B Report dissemination to Air Traffic Automation and BSCF

- Flight Information Services-Broadcast (FIS-B) Uplink via UAT

- Traffic Information Service-Broadcast (TIS-B) Uplink via UAT and 1090MHz ES

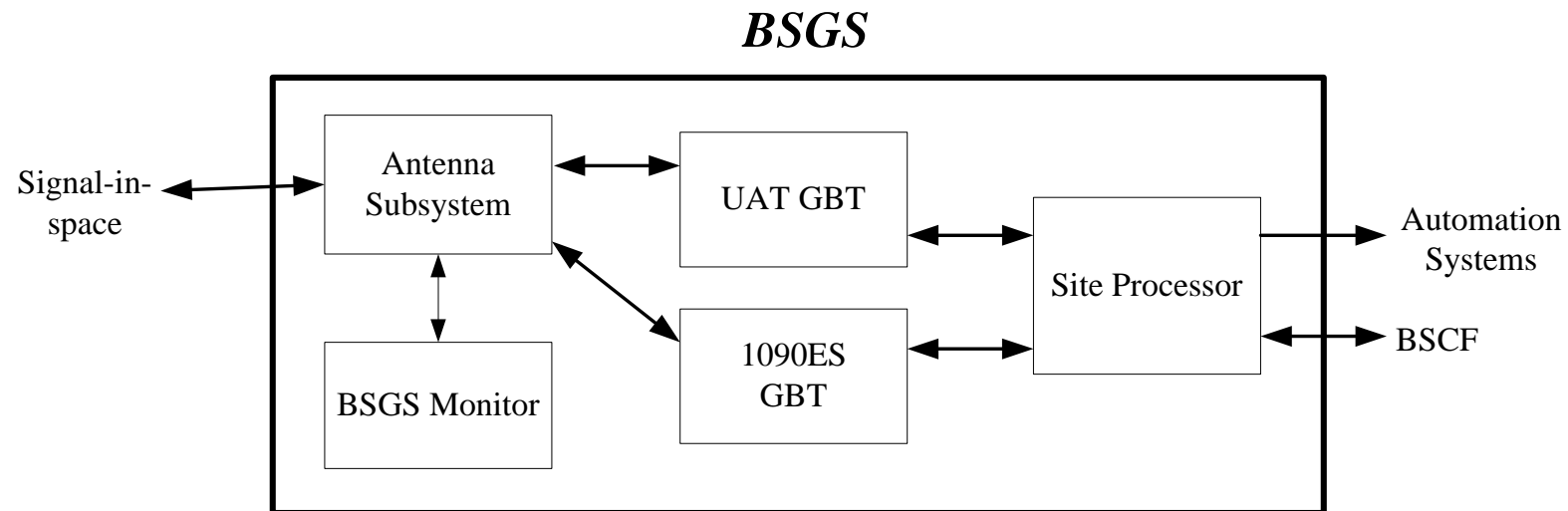- ADS-B Rebroadcast (ADS-R): provides ADS-B information from one link to the other
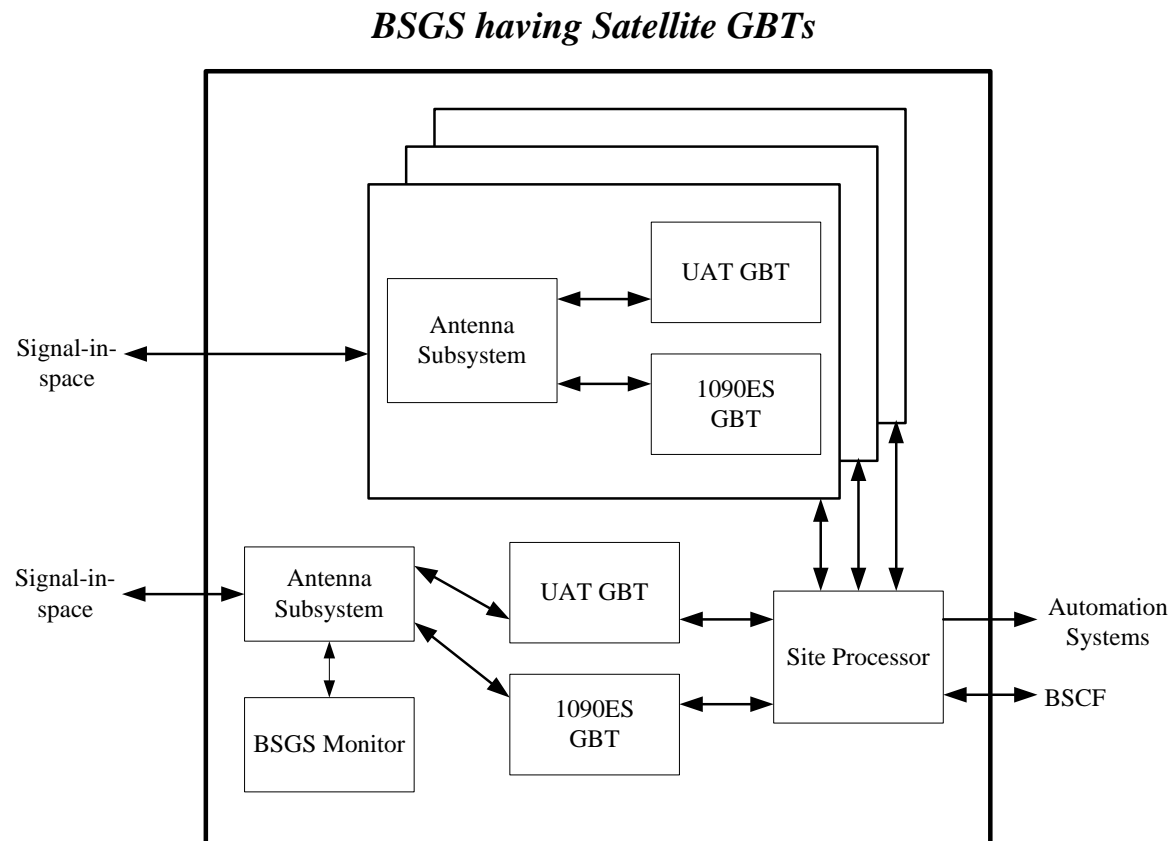
BSGS Specification Scope

- **BSGS specification is for a Broadcast Services Ground Station supporting terminal and en route applications as deployed in Segment 1 (2007-2012) of the Future Surveillance Program**

- **Radar coverage is assumed to provide a backup to ADS-B and support validation of ADS-B performance as Automation migrates to ADS-B**

- **BSGS includes both UAT and 1090MHz Extended Squitter Ground Based Transceivers (GBTs)**

- **BSGS Interfaces to Automation systems and a Broadcast Services Control Facility (BSCF)**

- **Appendix "A" discusses future requirements for Segments 2 and 3**

Subsystems of the Core BSGS

BSGS

Signal-in-space → Antenna Subsystem ↔ UAT GBT ↔ Site Processor → Automation Systems

Antenna Subsystem ↔ BSGS Monitor

Antenna Subsystem ↔ 1090ES GBT ↔ Site Processor

Site Processor ↔ BSCF

BSGS with "Satellite" GBT Sites to Provide improved Surface Coverage

BSGS having Satellite GBTs

UAT GBT

- **Must comply with the CAPSTONE UAT GBT specification FAA-E-2973 with a number of additional requirements needed for integration with the BSGS. Examples are:**

  - Perform geographic filtering for ADS-B reporting
  - Provide a visual indication as to which GBT at a site is the SELECTED where the operational GBT of redundant GBTs would be identifiable. Support inclusion of geometric altitude in TIS-B/ADS-R uplink
  - Support a 32 bit CRC for the BSDU instead of the current 16 bit CRC for Messages received and transmitted over the interface to the Site Processor
    - To ensure support of applications with "major" hazard classification

1090MHz ES GBT

- **Issues the following types of reports in CAT033 format to the Site Processor**
  - State Vector Report
  - Mode Status Report
  - Target State Report
  - Air Reference Velocity Report
- **Reports are output in two allowable modes**
  - Event driven mode – each 1090ES reception results in a CAT033 report going to the Site Processor
  - Periodic mode
- **Filters ADS-B Reports based on the following criteria**
  - Geographic Filtering
  - Surface vs Airborne status of ADS-B transmitter
  - By specific Aircraft or Vehicle address
  - ADS-B Transmitter Type indicated in 1090ES Message

1090MHz ES GBT (2)

- **Receives TIS-B and ADS-R reports from Site Processor in CAT033 format and transmits the appropriate number and type of 1090ES Messages**
    - Transmits all required 1090ES Message TYPE Codes
    - The number of repeats for each 1090ES Message is adaptable
- **Prioritizes TIS-B and ADS-R uplink traffic**
- **Generation and reception of Test Messages for operational monitoring**
- **Offers ethernet and serial interface options for operational data**

BSGS Site Processor Subsystem

- **Provides a single point of interface for all redundant and Satellite GBTs**
- **Purges duplicate ADS-B reports received from multiple, same link GBTs**
- **Performs rate limiting and provides full CAT033 ADS-B Reports**
- **Performs ADS-B Re-broadcast (ADS-R)**
  - 1090 →UAT and UAT → 1090
  - Inhibit ADS-R for ADS-B receptions that are indicated by the BSCF as failing validation based on radar input to the BSCF
  - Inhibit ADS-R if Site Processor determines a given target is detected on both links
  - Limit ADS-R to non-precision due to latency
- **Route TIS-B/ADS-R for uplink to appropriate GBT(s) based on adapted uplink service volumes for each GBT**
- **Routes FIS-B Reports to UAT GBT**
- **Conduit for GBT status reports and GBT maintenance data to BSCF**
- **Manages channel reconfiguration automatically**

BSGS Interfaces

- **Preferred Site Processor external interface is Ethernet (with serial accommodated where needed)**

- **Operational and maintenance data can be combined but the bandwidth utilization by maintenance data is limited in order to protect operational data latency**

- **CAT033, to be published by EUROCONTROL as ASTERIX format when finalized, is basis for all ADS-B/TIS-B/FIS-B/ADS-R data flow**

- **CAT023 will be used and expanded to include required new data items for Status Reporting**

Redundancy Management

- **The BSGS is channelized into two separate channels**
- **UAT GBT, 1090ES GBT and Site Processor Subsystems are redundant**
- **Satellite GBTs may or may not be redundant**
- **Antenna and BSGS Monitor Subsystems are not redundant**
- **The SELECTED Channel is connected to the antenna and is thus providing live ADS-B Reports**
- **The Site Processor performs automatic switchover based on specific events**
- **Manual switchover can be performed over the LMI or RMI**

Maintenance Data

- Each BSGS subsystem can be accessed locally via the LMI or remotely from the BSCF via the RMI

- Each subsystem is individually addressable for control and reading of parameters

- BSGS uses Simple Network Management Protocol (SNMP) for maintenance interface

- Simple Asynchronous Interface (SAI) provided to Remote Monitoring and Maintenance System (RMMS) from the BSCF

BSGS Schedules and Milestones

- <u>Aug. 2004</u>: Initial Meeting

- <u>July 2005</u>: Initial Draft Specification to FAA

- <u>Nov. 2005</u>: Second Draft Specification for Industry RFI

- <u>Apr/May 2006</u>: Third Draft Specification for Industry Comment (infuse operational experience from Capstone / SF21)

- <u>July/Aug. 2006</u>: Completion of Specification(s) followed by issuance of an RFP